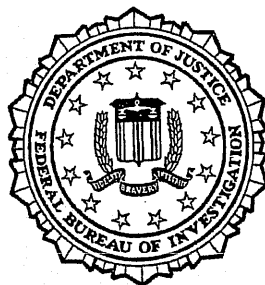


**Proceedings
of the
International Symposium
on
Forensic Hair Comparisons**



**Host
Laboratory Division
Federal Bureau of Investigation**

June 25 - 27, 1985

**Forensic Science Research and Training Center
FBI Academy
Quantico, Virginia**

WLF40278

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FOREWORD

Over the past several years the law enforcement community in the United States has placed extra emphasis on the solution of violent crimes. Extra emphasis, on the part of the laboratory, means learning more about a criminal from the evidence left at the scene of a crime.

Advances in applicable instrumentation and hair examination techniques led the FBI Laboratory to host several meetings of a working group of forensic hair experts. The ultimate goal of this working group was to publish a definitive volume of forensic hair examinations. That goal is largely reached with this proceedings.

The working group recognized that in order to obtain the newest and best information relating to forensic hair examinations, they would have to gather scientists from industry and academia, as well as forensic laboratories at a single forum.

The FBI Laboratory, in conjunction with this working group, hosted an "International Symposium on Forensic Hair Comparisons" at the FBI Academy from June 25-27, 1985. This symposium was attended by 172 scientists from industrial, university and forensic laboratories around the world. Prominent scientists from the United States, Australia, Canada, France, Great Britain, India, Japan, China, Switzerland and West Germany attended lectures on topics such as hair growth, the chemistry and morphology of hair and the comparison of hairs by protein analysis, to name a few. In addition, short oral presentations and poster sessions described techniques for examining hairs.

The exchange of ideas at this symposium will undoubtedly generate future research interest into forensic hair comparisons and result in a strengthening of the scientific merit of these examinations.

On behalf of the FBI, I would like to thank all those who participated in making this symposium a success.

WILLIAM H. WEBSTER
Director

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PANEL DISCUSSION
EVIDENTIAL VALUE OF HAIR EXAMINATIONS

PANEL MODERATOR: *John W. Hicks*, FBI Laboratory

PANEL MEMBERS: *Harold A. Deadman*, FBI Laboratory
Peter R. De Forest, John Jay College
Barry D. Gaudette, Royal Canadian Mounted Police
Geoffrey M. Rife, Metropolitan Police Forensic Science Laboratory
Manfred Wittig, Bundeskriminalamt

Hicks: We sincerely appreciate the enthusiasm of those who have participated in our program and their willingness to participate. I think it has made a much richer program to this point and so my thanks go to you.

Our goal in this symposium has been to bring together the perspectives of industry, academia and practicing forensic scientists, and to create a forum for discussion. Through this process, hopefully, we will develop a better understanding of a topic area; gain a better appreciation for the various individual perspectives and our mutual interests; and identify areas that are needed for further research and inquiry. So I hope that through this meeting these goals will be the end result for us.

The panelists are Barry D. Gaudette, Chief Scientist for the Hair and Fibres Section for the Royal Canadian Mounted Police in Ottawa, Canada; Dr. Geoffrey M. Rife, Chief Scientific Officer for the Metropolitan Police Forensic Science Laboratory in London, England; Dr. Manfred Wittig, Scientific Director for the General Biology Section for the Bundeskriminalamt in Wiesbaden, Federal Republic of Germany; Dr. Harold A. Deadman, Special Agent assigned to the Microscopic Analysis Unit, of the FBI Laboratory in Washington, D. C.; and Dr. Peter De Forest, Professor of Criminalistics at John Jay College of Criminal Justice in New York City.

Each of the panelists will make a brief statement on the status of hair examinations within their respective country, in their respective agencies and then perhaps include a comment as to the assessment of the significance and the value of hair comparisons.

Gaudette: Hair examinations have been conducted in the Royal Canadian Mounted Police Laboratory system for the last 46 years. We now have approximately 24 hair and fiber examiners in our system. Every year our system receives over 1000 cases in which hair comparison is involved, and every year our examiners spend a total of more than 200 work days attending court giving testimony about forensic hair comparison. These figures

demonstrate our belief that forensic hair comparisons are valuable and that hair comparison evidence is good evidence. In determining the evidential value of hair comparison or any other physical or associative evidence for that matter, the fundamental question to consider is not what proportion of the suspect population would have hair with a particular set of characteristics, but rather what is the value of the evidence in establishing a particular association. The fundamental question incorporates the frequency of occurrence aspect implicit in the first question. It also deals with many other factors including (1) the probability of incorrect association resulting from the occurrence of other prerequisite events (with hair this is the probability that one particular hair type out of the approximately nine types on the scalp would be the one to be found in evidence); (2) the probability of examiner error; and (3) the probability of incorrect association due to other factors such as secondary transfer, contamination, or deliberate planting of evidence.

When we consider all these various factors and all the variables involved in a particular case it can be seen that it would be extremely difficult (if not impossible) to give exact statistical answers to the fundamental question for each individual case.

Does this then mean that statistical determination of evidential value of hair should be abandoned? I think not. Consideration of the factors involved in statistical evaluation of hair comparison evidence helps an examiner develop a conceptual framework that can increase his or her understanding and be of assistance in making several important decisions such as research design and research priorities. Furthermore, since laymen have little intuitive feeling for the value of hair comparison evidence, evidential value statistics can be informative in court testimony provided that they are used properly.

To provide proper statistical evaluation of hair comparison evidence an examiner should first insure that the statistics used relate as closely as possible to the fundamental question. Second, insure that statistics are placed in the proper con-

text and that their limitations are pointed out. Third, state and substantiate all assumptions made in obtaining and using the statistics.

An approach in which quantitative average probabilities are used as touch points which are then modified by qualitative statements seem to best satisfy these requirements.

With hair this involves citing average probability figures such as 1 in 4500; pointing out the other factors involved; citing those factors which make the hair evidence in the particular case stronger, much stronger, weaker, or much weaker than that indicated by the average probabilities, and giving a qualitative statement of the overall effect relative to the average probabilities.

Although it is not without drawbacks and limitations I recommend this touch point approach as being the best available means of determining the evidential value of forensic hair comparison in a particular case.

One other requirement before you can use any of these statistics is to have proper training. In our system we submit the examiners to a 15-month program of understudy training during which time they have to pass comprehensive written and practical examinations; do a large number of reading assignments; and successfully complete a mock trial and a research project. They are taught a number of basic skills. I think proper training is a prerequisite to determining good evidential value of hair comparisons.

Roe: I am not in a position to give any figures for the number of hair examiners in the United Kingdom because as far as we know no one has actually counted them. In addition, I cannot provide any figures for the number of cases involving hair examinations, because to my knowledge no one has ever even attempted to count them.

There is a basic reluctance among examiners in the United Kingdom to examine hairs because of the generally low to very low evidential value put on most hair matches by the average hair examiner in the United Kingdom.

There are some who would put a very low value on all hair matches, and some (who perhaps more realistically I would like to think) vary the strength according to the case, the type of hair, the match and so on.

In every case in which hair is examined a comparison is made by one officer and always checked by a second officer. In some special cases a third or even a fourth officer is called in to examine the same hairs.

Any differences of opinion between the first and second officers are resolved initially by discussion and, secondly, if that fails by following the basic rule, "If in doubt, throw it out."

Obviously, whenever the circumstances of the case indicate likely alternative sources when a

match has been found, then control samples from those known alternative sources are sought from the police.

We follow the procedure by sending a written statement to court. It always includes not only the finding, but also an evaluation of the significance.

Because of alteration on the part of all the hair examiners in the United Kingdom, the controlling officers phrases such as, "could have" and "could well have" come from particular sources are the most commonly used. "Could well have" is rarely used. Recently I went to court on a "one could very well have." It was a strong case.

We never give any figures for an estimate of probability of the value to be put on our meaning of the word "could have." "Could have" simply means, "Yes, it could have."

We generally add a rider, "However, hairs of this color or type are common in the British population," and this obviously is dependent on the individual experience of the reporting officer.

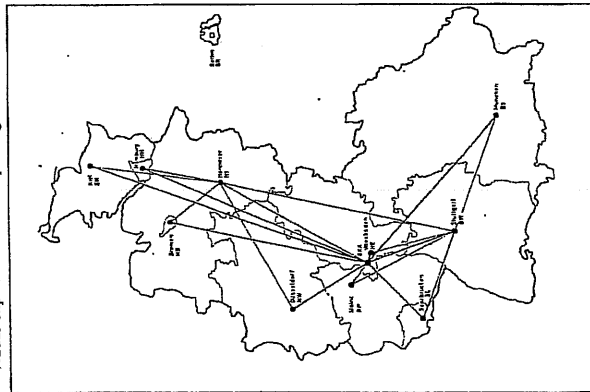


Figure 1. Map of the Federal Republic of Germany. Spots represent the 11 Länder and West Berlin.

We feel that until we have a large data base for each hair characteristic we have to rely on our own experience in presenting evidence in our courts.

The final comment, the United Kingdom Forensic Science Services does have a coordinating committee called Inter-Laboratory Advisory Committee (ILAC). Currently there is one specifically for hair. Shortly it will be amalgamated with the Committee for Fibers as I understand.

The ILAC does set up both declared blind and, allegedly, undeclared blind trials which are sent to all the laboratories in the United Kingdom. These are expected to be treated as normal forensic case examinations.

These have shown some considerable discrepancies between examiners in the occurrence of both type I and type II errors. This further reinforces our view that we should never overstate the strength of our hair match in our courts.

Currently in the United Kingdom there is no formal training program for hair examiners. This is something I think we can learn an awful lot from the Canadians and the Americans. It is something I think we really should have.

Wittig: Essentially at this time we regard the examination of hair in a similar manner as my colleague from Britain, unfortunately.

To explain the forensic science system in the Federal Republic of Germany, I refer to figures 1-3. This is the Federal Republic of Germany (Figure 1), and you will see there are 11 black spots plus 1 white spot. These are the 11 Länder, (comparable to your states) and West Berlin.

In all these Länder there is a Landeskriminalamt with its own laboratory. Of course there are communications between these laboratories as shown by the lines.

The next two figures (2 and 3) are copies of a former effort undertaken by Dr. Curry of the HOCRE in the United Kingdom. In the early 1970s, he listed all police-associated forensic science laboratories within the member countries of the European Economic Community (EEC). Their location and distribution are shown in Figure 2. In Figure 3 the circles numbered 31 to 42 represent the different Landeskriminalamt and the Bundeskriminalamt. You can see which facilities (divisions) are established there.

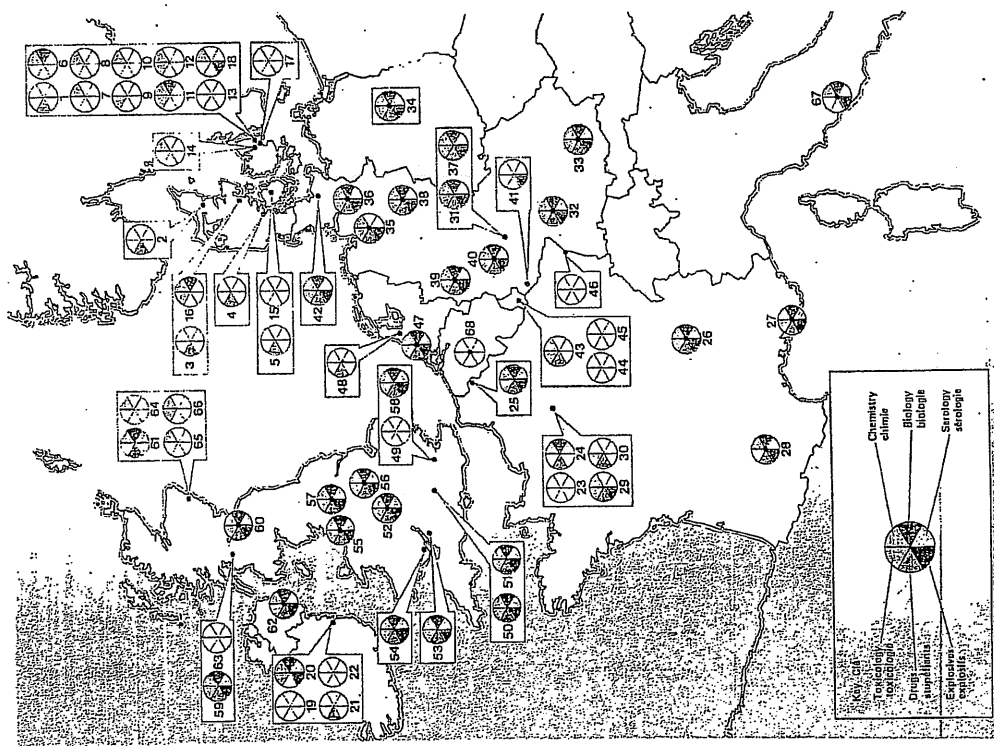
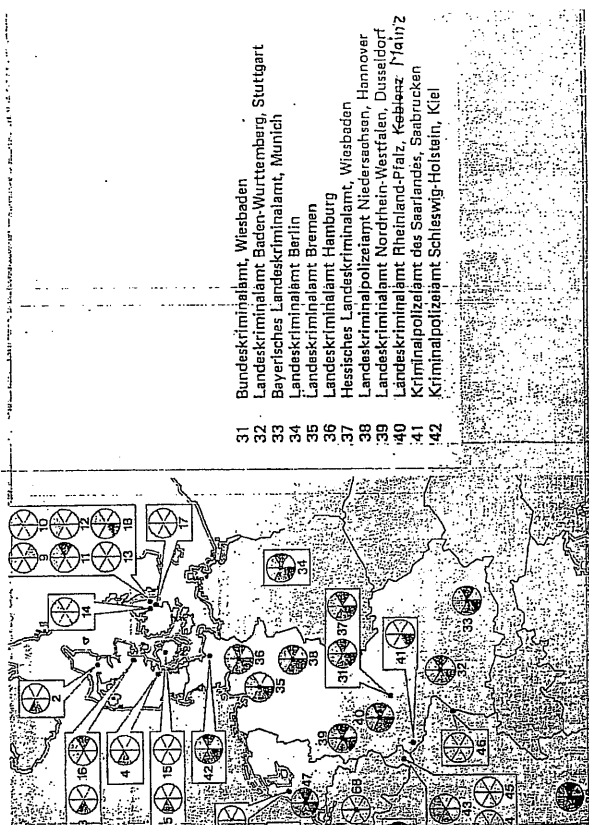


Figure 2. Police-associated forensic science laboratories within the member countries of the EEC. The key for the shaded regions is in the lower left corner of the map.



- 31 Bundeskriminalamt Wiesbaden
- 32 Landeskriminalamt Baden-Württemberg, Stuttgart
- 33 Bayerisches Landeskriminalamt, München
- 34 Landeskriminalamt Berlin
- 35 Landeskriminalamt Bremen
- 36 Landeskriminalamt Hamburg
- 37 Hessisches Landeskriminalamt, Wiesbaden
- 38 Landeskriminalpolizeiamt Niedersachsen, Hannover
- 39 Landeskriminalamt Nordrhein-Westfalen, Düsseldorf
- 40 Landeskriminalamt Rheinland-Pfalz, Koblenz/Mainz
- 41 Kriminalpolizei des Saarlandes, Saarbrücken
- 42 Kriminalpolizei Schleswig-Holstein, Kiel

Figure 3. Enlarged map of the Federal Republic of Germany illustrating the Landeskriminalamt and the Bundeskriminalamt.

Table 1 shows the situation within Federal Republic of Germany Forensic Science Laboratories with regard to hair investigations. The first two columns list the number of staff scientists and technicians who regularly do microscopy of hair (the number inside the brackets indicate additional personnel who occasionally do microscopy of hair).

The third and fourth column figures approximate case load per year in absolute and in percentage. In other words, investigators do not do hair cases exclusively, none of us do hair investigations exclusively. What their responsibilities are beside hair investigation may be very different.

Table 1. F.S. Hair Investigations in LKA and BKA (FRG)

F.S. - Lab	Staff, Sc./Techn.	Hair cases p.a. abs.	Data sheet	Analyt. methods
Baden-Würt.	2	170	65	E
Bayern	2(+2)	80	45	E
Berlin	1	40	20	-
Bremen	-	-	-	-
Hamburg	2	30	30	S
Hessen	2	90	40	-
Niedersachsen	2(+1)	200	25	E, S, B
Nordrh. - Westf.	3(+1)	160	30	E, S, B, SEM(EDX), (TLC)
Rheinl. - Pfalz	2	90	25	E, TLC
Saarland	-	-	-	-
Schlesw. - Holst.	1	10	10	-
BKA	1(+1)	30	70	E, S, B, SEM(EDX), (TLC)
	18(+5)	17(+3)	900	10 - 70
				±

Depending on the personnel situation within the laboratories some of us have to do a variety of different investigations. In other words, they are generalists. Others are able to specialize.

The fifth column lists whether a data sheet is used or not. Most of us say yes and no. It depends. There is one who claims to use a data sheet always and there are three who say they never use it. What methods other than microscopy are available and could be added from case to case is given in the last column called "Analytical Methods." E means enzyme typing; B blood grouping (ABO); SEM with or without EDX; and TLC.

NOTE: The reader is referred to Dr. Wittig's post-panel discussion section.

Dresden: In the FBI Laboratory the hair and fiber cases are assigned to the Microscopic Analysis Unit. We have 11 Special Agent Examiners in the Microscopic Analysis Unit; 10 of which are involved in actual cases. Each examiner in the unit specializes in primarily hair examinations and textile fiber examinations, and also examinations of various textile materials.

They are grouped together primarily because we rely almost exclusively on microscopical techniques for the examination of both hairs and textile fibers. We are involved in approximately 2000 cases per year, and testified 250 times on hairs and/or fibers. On occasion, an examiner in our unit is trained in

sample, from one individual, would match in the sample, or among hairs in the other sample.

We are also involved with taking matching tests in our training program and our other activities. The experience of the Canadians in the tests they utilize in their training program I believe demonstrates that individuals can do an excellent job of matching hairs with the source that they originated from.

In the training of students in our hair and fiber school, I routinely look at the hairs generally of each student in the class. Admittedly, this is a random group of 12 individuals that usually involve different sexes and different races, but a test set up with hairs from those individuals would generally be a very trivial test. It would be no problem for an inexperienced examiner to take a matching test utilizing hairs from students in the class and not make any mistakes in terms of making the proper associations.

So we believe in hair comparisons. Certainly the strength in the association depends a lot on the hairs, the characteristics that the hairs exhibit. Some hair matches are not perhaps the basis of a strong association. The common featureless hair Barry Gaudette has described in some of his writings perhaps is not an association that should be argued as a strong one in court. But when hair matches involve hairs that have very individual characteristics, uncommon characteristics, when you have multiple hairs forming the basis of your association, and a variety of other factors, all of which contribute to the strength of the association, we testify in some instances quite strongly about hairs.

Certainly hair evidence being trace evidence is often accompanied by other types of trace evidence which form the basis of our associations. I rarely have had a case in which I testify only to hair evidence. Often there will be fiber evidence involved. Often other examiners will testify and the combination of the hairs along with the other evidence often results in extremely strong associations.

De Forest: I am going to discuss the evidential value of hair. Then I will discuss some of the defense expert's perspectives on the hair question. Although I do some civil work and occasional prosecution work as well, I would like to share with you some of the perspectives I have in doing defense work.

I think we all agree that hair is good evidence. It is an appealing kind of evidence because of its ubiquitousness; its frequency of occurrence at crime scenes; and its stability as contrasted with some of the biological types of evidence.

We all realize it is difficult; we are talking about a subjective process in comparing these things and it is also a great time-consuming process when done properly. But it works.

Things that make it complicated were indicated in the presentations by Richard Bising (pages 35-44 this proceedings) and others. The large number of variables we are concerned with have to be simulated somehow in the mind, and we are talking about a large number of continuously variable parameters. We have to also take into account the fact that combined with this complexity is the complexity of significant intrasample variability.

The power of hair examination is based on the *a priori* potential to exclude hair. In other words, if you receive two samples, a known and questioned sample, the power of the technique is based on its ability ahead of time to exclude these.

At worst, hair evidence is very competitive with other kinds of non-absolute associative evidence. Because of the type of selection process that goes on and the fact that we are talking about randomly selected hairs being submitted, there are many times when an exclusion is trivial. And so for that very reason the advantage of being able to exclude hairs that are obviously different, has value that is competitive with other kinds of evidence such as limited blood typing, and so forth.

It is when the hairs that have been brought in are similar to each other (the known and questioned are similar) that we, of course, face the difficulty of the long hours and long involved examinations. We really basically come down in the end to failing to exclude the hairs and concluding from that, and interpreting that failure to exclude as a match or an inclusion.

I think for the foreseeable future, as others would agree, microscopy is going to be our approach to the sexing, typing and so forth of hairs with the help of adjunct techniques such as electrophoresis of the enzymes and root sheath, etc. Despite the fact we are going to have microscopy with us for a long time I see no way around that. I think we should proceed with work on developing other techniques that would make this process shorter, less time consuming and more objective.

Now I will provide the perspective of a defense expert. The approach I take when I am contacted by an attorney is basically to look at who has done the work on the case and what kind of procedure has been followed. Normally, I advise against a re-examination, and there are reasons for that.

First of all, to do a bona fide re-examination will take many many hours and I do not work for free. So it makes for very large bills which I think are ridiculous in light of the fact that I do not anticipate finding something different. In other words, my prediction about being able to come up with an exclusion that would please the defense at the end of the examination I think is an outside chance. I have only had one case in which I have disagreed with another examiner and that was a case in

which the other examiner did not examine the hair. The report simply said the hairs were inadequate for examination. I thought they were adequate on the basis of exclusion, but you know generally the bottom line is that you can predict ahead of time but you are not going to find enough to really say test. In other words, if the other examiner says these things are similar you can be pretty sure they are similar and you are not going to be able to come up with any sound basis for coming up with an exclusion.

I point that out to the attorneys. So only on rare occasions when they insist on the hairs being analyzed will I go ahead and perform the examination. Once in a while I will agree to look at a sample for a few hours just to indicate there is no obvious thing wrong with it. If the attorney has some uncertainty about the competency of the people that have done the work on the case he may ask if that can be done and I will agree to that, but I make it very clear that is not a full analysis.

Now there are a few horror stories I can tell and I will limit these to a few. There are incompetent, dishonest, or at least naive examiners on both sides of the fence.

Here are two pictures that illustrate what we encounter. When you see a state's exhibit like this it leads one to question the competency of the examiner or his experience.

Figure 4 is the known sample, three hairs. We have basically hairs that are 9 to 12 inches long and 22 millimeters of them are covered by mounting material. With that kind of thing you really cannot imagine that the examination had been a thorough examination. But at the same time I would not hold out too much hope that I am going to find a difference.

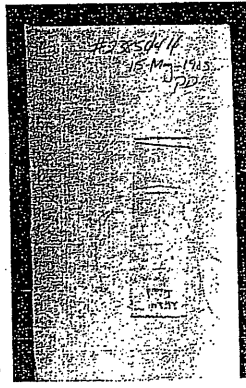


Figure 4. Three hairs of the known sample.

Now I made a request through the defense attorney and through the state to remount the hairs. I have now dismounted these so Figure 5 serves as the documentation of how the hairs looked before I dismounted them.

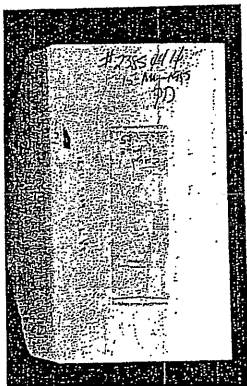


Figure 5. The known hairs before dismounting.

An incompetent examiner can survive for a long time, maybe forever. Let us look at why for a minute. The reports from this particular laboratory that does this work in these cases are all about the same.

The hairs consisted, or the sample consisted, of brown hairs with flattened imbricate scales with a diameter of 70 mm units. What does that mean?

In a case such as this the examiner is likely to be given hairs that do match ultimately. The fact that the police investigation conducted by competent people (investigators and so forth), in all likelihood, these hairs are going to ultimately turn out to match. So there is not too much danger of contradicting the state's conclusions in this case.

Prosecuting attorneys and defense attorneys, both are only concerned with the case at the moment, the case at hand. They do not really care about what happens down the road so efforts that might knock something out of the water do not often succeed. They reappear and reappear.

On a few occasions the hairs that are received by a laboratory like this or an examiner like this would be grossly different and they can safely conclude that these hairs were not from the same source. So it is no great challenge and they can remain the experts for a long time, if not forever.

I had one case in which I know the individual knew nothing about hair examination. I was asked to examine the hairs and concluded they did in fact match. They could have come from the same source and the other examiner went around crowing. "See I was right all along, I was right all along." They will be right most of the time.

Some defense expert types are a source of aggravation for me. There is the individual that agrees to do a reexamination on a case and drives 2 hours to the prosecution laboratory, spends 5 minutes peering down the ocular of the comparison micro-

scope and says, "Yep, they match." Maybe 3 minutes and then takes his fee and goes home.

Now that may not seem like a very objectionable thing, but at least you are not having the nuisance value of this thing being challenged by something like this. But I think it is a very unethical type of rubber stamping.

There is also the smoke screen tactic. The defense expert who is called into a case, and with the help of the defense attorney, gets a hair from a juror or somebody in the courtroom, brings a microscope in and compares that with the questioned hairs in the case and says, "Yes, they are similar." What does similar mean in this kind of case? It confuses the jury. Then once in a while you will get a defense expert that has the temerity to open up and disagree with the state without any basis of fact, and these people are also hard to deal with.

Hicks: We will now accept questions from the audience.

Let's in an earlier presentation Dr. Deadman mentioned something about collection of hairs and Mr. Roe mentioned using scotch tape. Some of you probably have had the experience of using a vacuum cleaner. I would like the panel to comment on collection and give an opinion on which is the best method.

Hicks: Dr. Roe, would you like to address that?

Roe: Certainly. In the United Kingdom the recommended method of collection of hairs is first to visually examine the item, usually garments or bedding. Any hairs observed should then be picked off and put onto slides in Permout[®], or if you consider the cosmetic situation placed in polyethylene bags and labelled appropriately.

Following this and assuming no interfering problems; that is, the chemist wishing to look for glass, paint, or whatever in which case they are not happy with adhesive tape, we go over all appropriate items with adhesive tape totally and on appropriate surfaces. Generally this is outside, but depending on the case we may tape all surfaces in and out.

We do not like scraping, particularly from the point of view of fibers as I mentioned. We do everything but hairs first and fibers with the full range of techniques available we will stand in our present frame of mind, which I am not saying is always correct, just usually. It will give you a much better chance of good evidence. Two-way transfer is usually close to a certainty for fibers and you have a chance of finding that.

Taping would be primarily used for fibers. We would pick up the extraneous hairs that were missed in the initial scan.

Hicks: Dr. Deadman, would you address the scraping?

Deadman: I look at evidence recovery as involving several factors: the circumstances, the type of evidence, the situation, the facilities in your laboratory, the contamination, the efficiency of recovery, possible loss, and the time involved.

Generally our unit is set up so that we scrape items of clothing after visual examination. Generally a number of hairs will be pulled off of an item and placed in a pill box. The item will then be scraped in a room that is isolated from the rest of the laboratory. The debris is collected, then placed in a suitable container or pill box.

In a case in which we are trying to associate items from a suspect to a victim, the items would be handled in a separate room at a different time by a technician wearing a different laboratory coat.

Generally we rely on a scraping technique. Although it is perhaps not as efficient as tape it does collect considerable evidence. If done properly I think you can avoid the possibility of contamination and it certainly is a much quicker technique.

Hicks: Dr. De Forest did you have a comment?

De Forest: I think the important thing to tie this all together is the fact that there is a preliminary visual examination that precedes either the scraping, taping, or vacuuming.

I think one of the biggest ills that we face is the indiscriminate collection of garbage. I think particularly vacuuming is very much abused particularly when you get a vehicle which has layers and layers of stratified cans of deposits and the collector just combines all that in one big bag and expects you to go through a million fibers or so to pick out something that may be used to associate the car with some person.

So there are really two questions. One is the kind of sampling that is done in the laboratory under controlled laboratory conditions; and the other is the kind that is done in the field. I think in both cases there has to be some thought put into the process of doing that. It has to be a selective knowing process. You have to see what relates to the event being investigated, what things are most recently laid down and so forth. It cannot be done by the numbers or blindly.

Hicks: Another question?

Sims: Mr. Gaudette, for the examiners who do not have the statistical background behind them, what do we tell the district attorneys when they look us in the eye and say give us a probability for the hairs? What would your advice be on how we should approach them, what should we tell them with regards to your articles and what would we testify to on the witness stand?

Gaudette: What you can tell them obviously is going to depend on whatever you feel comfortable with yourself. There are a number of ways of get-

ting across the value of hair evidence. Statistical data is only one of these kind of possibilities.

You can quote additional studies in the literature that have been done by other authors. You can do some tests yourself. One of the things that we try to encourage our people to do is to take 100 questioned hairs and compare them all to a known sample and see what kind of results they get. Assuming you get good results on a test like that you can use that kind of example, provided you used it only as an example, and you did not try to get any statistical data from a study like that. That would be another way of approaching it.

If you do wish to use my statistical data, the way I suggest it being used is just as a sort of an anecdote to explain what one investigator found with regard to the evidential value of hair and as I indicated to you earlier this is only a touch point average approach. It cannot hope to cover the circumstances of any and every particular case. But we do need some kind of data as everybody will appreciate because many people do not know whether every other person's hair is going to match or whether it is one in a billion. So I would just simply cite it as one example.

Again another consideration, depending on your individual law would be with regard to the hearsay rule as to how much you can go with another examiner. Then if you did quote you should be cognizant of that.

Question: I would like to make a comment and challenge the panel to make some statements from a statement that Dr. De Forest made. For years I would go to court and testify, and the attorneys would say, "Is it not true that the only thing you can say about this hair is that you cannot eliminate it?" That is a very sore point or a difficult thing for me to comprehend, because I very much believe in a more positive approach to a hair comparison, that it is not merely looking for an elimination and that is not the only value in doing the hair comparison.

When you come from an area in which 70 percent of the people, have the same last name, the number of eliminations that you actually make are very small. I choose to think of saying either a positive statement of association or no statement of association unless it is an obvious elimination. I would like the panel to comment on that.

Gaudette: Maybe it is really a semantic question. I do not think one should take a defensive attitude toward that question. Really what you are doing as a scientist is making an aggressive effort to exclude these hairs. When, after making this very thorough effort you are unable to do it by employing all kind of criteria, that is a great accomplishment. That is the basis, then, for your concluding that these could have had a common origin. So I am not sure

I really appreciate the defensive nature of the reaction to that kind of a question from an attorney. I think you can answer that question very readily and point out it takes a great effort to arrive at that point. That is really what we do with any kind of non-absolute, associative evidence.

Hicks: Does that answer your question?

Question: Well, listening to the initial presentations by the panel members, there is very much a difference in approach as to how positive somebody is about hair association. It goes from Mr. Gaudette and Dr. Deadman with a very positive approach to a wishy-washy approach and I find this very interesting. I find attorneys have a very negative approach toward hair comparisons. I like to think of my work as being positive or associative and working for the positive or associative evidence, not so much from the point of view of an elimination. I just thought I would stimulate a little conversation.

Gaudette: Along that line I would mention a recent paper that I had written entitled, *Strong Negative Conclusions in Hair Comparison - A Rare Event* (Gaudette 1985). I think that title says it all. I do not think you can often positively eliminate a hair as coming from somebody and that is because of the presence of atypical hair.

Mann: I have two questions but first I would like to address the audience. How many people/aboratories represented here actually use electrophoretic techniques in their casework of hairs?

Hicks: There appears to be a response of approximately 40 percent of the 170 people in the audience.

Mann: I would like to address this question to the panel. The examination of body or limb hairs is a touchy subject, that is, the comparison examination of these hairs. And yet, sometime in our careers we will inevitably work on a case involving such a comparison. I would like each of the panelists to comment on that, particularly with reference to their confidence levels regarding the comparison examination of limb hairs and how they would testify if they went to court on it.

Gaudette: We occasionally deal with limb hairs. Usually they are more often investigative aid type cases or sudden death that sort of thing. The strength of any conclusion or any comparisons with regard to any of the limb hairs is obviously much less than it would be with scalp hairs or public hairs.

However, again there is the possibility that even limb hairs can have some unusual characteristic, some unusual adhering debris. There is no doubt about it, that you certainly cannot go nearly as strong as another hair type.

Hicks: Dr. Roe.

Roe: Occasionally I have had cause to examine hairs from various parts of the body. Like Mr. Gaudette I think the value of the match is likely to be significantly less than that of the head hair match.

One problem we occasionally encounter is even if we find some in a case they are more likely to be refused as samples than head hair. I cannot speak for any other examiner in the United Kingdom because as far as we know there is no collective data on limb hairs. I would have less confidence in the match.

Hicks: Dr. Wittig.

Wittig: I will illustrate with a case about public hairs. In our case, three finger hairs were found in the stockings of the victim which did not match the victim's hair. In the first approach there were other different hairs, especially head hairs, and all of these matched the victim hairs.

In the second submission there were public hairs from a suspect together with the head hair. With respect to public hair comparison we found two items of evidence; trace material of the hairs, one matched microscopically and one did not. Possibly this was not a public hair. It was possibly an axilla hair. So in that case it did not match with the victim's hair. There were no other suspects in question.

In addition, we did ABO typing in this case with all three evidence hairs. All three gave very strong OA, the same as the suspect had, but the victim I recall had O.

We presented before the court two of the three questioned hairs found in the stockings of the victim which did not match their own, two of them matched microscopically with the suspect's hair. In addition, in a different system, namely ABO, there was also a match, the same in the questioned suspects.

One can stress and even positively support a point of view, but we do not give figures of frequency, of course, in ABO.

Hicks: Dr. Deadman.

Deadman: Generally I would compare only public hairs and scalp hairs. In some instances of racial determination I may comment on the racial characteristics in the limb hair but I normally will group limb hairs, arm hairs, leg hairs other body hairs into a category of hairs that are of no value for body area determination or association with a particular person. And I will try to work only with what I consider to be good public hairs and scalp hairs.

Hicks: Dr. De Forest.

De Forest: I would echo the use of them certainly as investigative aids and use adjunct techniques with them.

Question: From the audience.

Question: I am a little dismayed by the feeling expressed by Mr. Roe as to the examiners in your country. Are those same examiners afraid to perhaps report on a single layer house paint, or perhaps a silver of window glass, or perhaps a bloodstain that just gave an ABO antigen reaction?

Roe: You must appreciate, of course, the same examiners would not be examining glass and paint. ABO obviously is a rather different situation. You know it is an A. There is no question. It either matches or it does not match. You also have frequency figures for that result.

Having your single ABO results you still have only a 40 percent frequency. It does not tell you a lot about the case, only you have a match.

The reason that many of the British and I suspect the German as well (but Manfred will have to comment himself), feel cautious about overstating the value of a match is that in court without any published figures on the frequency of occurrence on any particular character or combination of characters in human scalp hair on a large sample the defense can put significant pressure on you.

It is not safe when you are not backed up by the scientific community. The reason for the caution I think partially is the small samples which were actually examined. You have a hundred thousand plus hairs on your head.

In the United Kingdom we are lucky to get a sample with as many as 25 in it. We try to get a minimum of 25 and hope for more, but usually it is less. This is hardly an adequate sample.

Having that to work with you then select somewhere between 6 and 15 hairs, perhaps, for full examination. If the question were asked in court, "Given a small sample, is it possible that the apparent extremes of the range which you have examined are not the actual extremes of the range of the head from which the sample was taken?", you would have to say, "Yes, that is possible."

You are allowing therefore an increased chance of an overlap of hairs from one particular source and hairs from another source. It is caution in this area which causes our caution.

Hicks: Thank you. Another question?

Question: I totally agree with Mr. Roe. I think we should be more cautious to report the statistical probability of hairs. As you all know there is some probability called population genetics and we really do not know what the local data is. Also we still do not know what is the genetic importance and what characteristic is inherited, which is not. To report

the probability of the hair I think we should be more cautious.

I do not sit in my laboratory the probability statistics. I do not want an examiner to go to court with each hair, and the defense attorney ask of each hair, "Hair number one, what is the probability; hair number two; hair number three." There is no end.

I would like to ask Mr. Gaudette, how much sample did you study. In other words, what is your data base and did you find any variations? In my own head I have found five different kinds. So if I want to assign a volume on each of them I really do not know how to assign it. How do you handle those problems?

Gaudette: As I said in my opening statement, you are addressing frequency concerns which are really only a component of the fundamental question, namely, what is the value of hair evidence in establishing the association?

I think that is a problem with a lot of hair examiners, particularly those who are also serologists. They want to try to use the statistics in the same way that the serologists use their population frequency statistics.

I think that the kind of statistics that I generate in my study are probably closer, or at least one step closer, to the answer to the question that the courts are asking than any population frequency statistics would be. I caution the use of population statistics by themselves without putting them in their proper place. Because if you say with blood grouping this culmination of blood types is found in one person in 1000, there is a great danger that if you just simply say that and do not put it in its context the courts will take that as being that there is one chance in 1000 that their man is, or 999 chances in 1000 that the man is guilty. Either that or 999 chances in 1000 that the man was in association. Neither of those is the correct interpretation.

Hicks: Other questions?

Question: I would like to ask somebody on the panel a question, particularly Dr. Roe. You gave in your introduction your normal way of reporting hair comparisons and your normal procedure. I did not find that to be too much different than what most of us are doing in the United States. But you keep on mentioning the concept of overstating the value of the hair comparison. Excluding the overstatement that the hair can be positively identified, which none of us should be doing, what do you consider to be an overstatement of the value of the hair comparison?

Roe: An overstatement of the hair match would be quite clearly one in which the court got a stronger impression or likelihood of association of a particular individual with the questioned hairs than is realistic.

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It is very difficult to put into words.

Lee: Dr. Roe, maybe I can help you. I had a transcript sent to me to review. The examiner said he examined the hair without mounting it. This was his first conclusion. In a second conclusion he said in an absolute and unequivocal manner that it matched the suspect's hair. This kind of conclusion is really dangerous.

De Forest: I have a problem with the divergence from a laboratory report in which the conclusion is these hairs could have shared a common origin to the presentation of testimony in court when the expert says something to the effect that, "Yes, these hairs were found to be similar and in my experience I have examined thousands of hairs and I have never found two hairs from different sources that were alike." I think that is very misleading and it is not substantiated by any data. Any comment on that.

Question: I would like to hear another panel member's viewpoint on statistics. Dr. Deadman, would you share your philosophy in reference to Barry Gaudette's statistical work?

Deadman: I do not think I have ever made a statement dealing with statistics. I think I have used various numbers if a defense attorney has asked me about Mr. Gaudette's study and generally I relate my understanding of what the study consisted of and what the numbers meant.

A lot of people tend to use that number without really understanding how the study was set up and how that number really came about. As you read Mr. Gaudette's papers and go along to the fourth paper it gets much harder to understand what was involved. But then again, I know Dr. De Forest just said he did not like the comment that an examiner will get up in court and talk about his experience of having never seen hairs from different individuals that exhibit the same microscopic characteristics. I think it needs to be pointed out if that statement is made the examiner is not saying he has compared every hair sample that he has examined with every other hair sample.

But certainly an experienced examiner, when I am talking about hairs as the basis of a strong association, I am talking about a person who is experienced; a person who has the proper experience and the proper training.

If you point out that you are examining cases daily. You are examining hairs from multiple suspects, from suspects and victims and the first part of your examination involves comparison of hairs within the known samples. If you had the same criteria for a match in the hairs from the known sample as you would in a case, you would regularly find that hairs from different individuals exhibit different characteristics. I think that is a valid state-

ment and I actually feel it is the only basis you have for testifying that your hair match means anything.

I do not know what other basis you would have with the exception of, perhaps, Mr. Gaudette's study. If someone else has a basis out there for testifying this in court other than their own experience of rarely finding hairs from different individuals that match, I would like to hear what it is.

Hicks: Dr. Wittig, did you have a comment?

Wittig: Yes. There was no comment made that we do not put trust in a match. Of course we do, but what does it mean?

Another area I want to make a comment on, and I want Mr. Bisbing to help me, is with respect to his last paper published in which he computed twins. In cases where the circumstances allow you to make your statement before court in a verbal but different qualified manner, in other words, when there are some hairs provided from a given situation that belong together as from a twin, then you may be able to say there is an extra dimension for comparison. And under given circumstances of a certain number of suspects then you do in your comparison find all but one can be excluded. Mr. Bisbing, please expand on this.

Bisbing: You are talking about the difference between comparing and having for comparison a questioned sample that includes a large number of hairs from one source, because it is a clump of hairs or something. In those circumstances like Mr. Gaudette's statistics showed, the probability of a proper match, or the probability of an incorrect match is very low. In other words, you can with great certainty match up a group of hairs because you have the extra dimensions of more hairs and characteristics and a variety and a range of variables, as compared to a single hair which you have a much greater chance of making an error. Certainly with a twin we could tell the difference between all of our twin samples because we had a lot of hairs. But when we dealt with one or two single hairs we made errors, and I think that refutes the concept that you will not find hairs from individuals that are not the same. We explain it is unlikely to find two hairs from two different individuals that might be differentiated. In fact, we have proven again that you can find that situation occurring when two hairs from two different individuals indeed will match.

Wittig: But the same is true, do not put too much trust in single hair.

Bisbing: Yes, in comparison to a quantity of hairs a single hair comparison is much less reliable. I agree with Mr. Gaudette's work.

Deadman: In most of the hair cases I am involved in, I treat every hair as a single hair and

generally make single hair comparisons. I compare one hair with hairs from a known sample; again it depends completely on the characteristics.

If you have a common featureless hair, a relatively short light brown to brown, Caucasian head hair with no individual characteristics, nothing uncommon about that hair, its evidential value certainly does not rate a strong association.

If the characteristics in your experience are uncommon, the chance of finding a characteristic like that in the hair chosen or selected from an individual at random would be very low. I think then you can start to have strong associations and depending on the hair if it is a long hair, if it has a lot of variety, if it has a lot of changes in characteristics; and if your criteria for a hair match is set high enough, then I think you can work with single hairs with no problem.

Question: How does that relate to my original question about at what point do you overstate that opinion? At what point, Dr. Roe, do we reach the point where we have overstepped that bound of forensic conservatism?

Roe: I do not know. I wish we did know. We instinctively feel that dealing with a single or a small number of hairs which you have of necessity to treat as individuals that unless there is something fairly obviously significant, something out of the ordinary in the known sample, then the significance of a match is not likely to be very high.

When we have an unusual feature our opinion is obviously much stronger. There is little obvious coordination in the strength of stated opinion in court because that is something that is very difficult to control. It is something rather individual and based on experience.

I would point out now that I am not one of those who always feels the match does not mean anything. Two or three weeks ago, in evidence in courts in the United Kingdom, I stated the hairs in this case were unique in my experience and the match was significant. That is not to say I examined a fraction of the number of hairs that are examined by forensic scientists in America or Canada, because as I said before, we examine them only when we have to. This was a case in which we had to and it came up in court. That is sort of an internal pun. One of the suspects was called Trump. I never realized it, and the other one was Burn, but they were not signed.

We do not feel that most cases, most hair samples are sufficiently unique when dealing with a single hair to effectively rule out the chances of that hair having come from a majority of the samples, or even a large number of the samples. Overstating the case would be to allow that that was the case. Somewhere between our own conservatism and the American-Canadian optimism is the

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probable situation. Until we know where we are, we are going to be conservative.

I suspect we are too cautious.

Hicks: We can come back to that if you would like but let us now take another question from the audience.

Kerr: We have heard your opinion and your emphasis on hair examinations. Could you give us an idea of your administration's emphasis giving us an idea of the percentage of personnel devoted toward hair examinations versus all other types of examinations? It may be difficult for the FBI in that there are Drug Enforcement Administration; Bureau of Alcohol, Tobacco and Firearms; and other Federal laboratories in criminal investigations.

Hicks: If I understand your question correctly, it is what are the relative percentages of personnel within each country that are dedicated to hair examination. Is that correct?

Dr. Deadman, wasn't a study done recently that addressed that?

Deadman: I think it is hard to use figures of hair examiners from a variety of laboratories because many laboratories do not have examiners who specialize in hair.

In the FBI we have 11 examiners in the Microscopic Analysis Unit. We have approximately 14 full-time examiners in the Serology Unit who handle serology, body fluids and so forth; approximately 13 examiners in the Firearms-Toolmarks Unit; and a smaller number of examiners in other units.

The difficulty I think would be in that so many other laboratories have a generalist concept, so as far as determining what percentage of their time is dedicated to hair examinations, I do not know.

Question: How about from United Kingdom, Germany and Canada?

Gaudette: In the Royal Canadian Mounted Police Laboratory there are 24 hair examiners; hair examiners who do both hair and fiber. We also do physical matching. The total number of personnel in our laboratory system is in the neighborhood of 300, maybe 325. So if you are good at mathematics you can work out the percentages.

Roe: In the United Kingdom we have a generalist policy. Our system is based on case reporting officers who control the examination of the case. Any biological material that we are looking for will be dealt with by that one case reporting officer, and any specialist work done after the general identification of say blood is done by blood group technicians. Other things are also sent to speciality sections as necessary. The result then comes back to be checked, and I would also look at the hairs or I would have an assistant do that. Then it

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fices cooperate to the extent that they will submit contrived cases to the laboratory. They come in just as any other case and then the results go back to those offices. Those offices, in turn, submit the results back to the Forensic Science Research and Training Center at Quantico to assess whether or not the examinations were conducted as they should have been and the right answers were found.

Even though I am the Chief of the Scientific Analysis Section (the operational laboratory in Washington, D.C.) I am not given direct access to test results. That is administered at Quantico by Kenneth Nimnich, and he reports directly to the Assistant Director in Charge of the Laboratory.

That is essentially the quality assurance program. There are other practices (good laboratory practices) which contribute to the program. But that is essentially what our quality process involves. Mr. Gaudette, would you want to comment?

Gaudette: The Royal Canadian Mounted Police Laboratory program is quite similar to what Mr. Hicks has outlined for the FBI. Again it has many elements starting with proper training and the selection heads carefully monitoring the work of the people in their individual sections.

With regards to proficiency testing we have only a fairly rudimentary program which we have just begun in the last few years. We have not gone to the step of doing blind testing as we are only doing declared trials at the moment.

Our Director has stated that quality assurance is a high priority item within the laboratory and I imagine we will be seeing increased efforts in that area in the near future.

Roe: I think I have basically covered what we do in the United Kingdom during introductory comments, so I will ask Manfred to comment on the German situation.

Wittig: We have neither a quality assurance system nor do we currently do proficiency testing. We have also the ridiculous situation that prosecution and criminal police place a high demand on the value of hair to the laboratory.

On the other hand, some say because you do not want to give figures, the value of hair comparisons will not be valuable. Therefore providing laboratories with more hair is insufficient. We want, of course, more, but not at the price of giving figures which we cannot justify.

Hicks: Is there another question?

Bryson: Several of the panel members have mentioned adequate sample. I would like to ask each of the panel members to define adequate sample. I would like to know if this is based on the characteristics they find or if they have very stringent rules about the location of the hair on the body and the length of the hair that they always go by.

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Hicks: Good question. Dr. Deadman, would you please comment?

Deadman: The committee that was involved in coming up with a recommended procedure recommended 100 hairs from five different areas of the head and 20 hairs from each area obtained by combing and pulling.

In my own experience, prior to serving on the Committee I generally asked for 20 to 30 full length hairs pulled and combed as a known sample of scalp hair.

Bryson: Excuse me. I was referring more to considering a questioned hair for comparison, not what you require for your known samples.

Hicks: What do you mean by "known?" Considering what is suitable for comparison purposes?

Bryson: Yes, exactly.

Deadman: If I have a scalp hair or what I consider a good public hair - a hair that exhibits characteristics of the public region - I would consider those suitable for comparison purposes.

Now I admit there are a number of hairs certainly on male heads that are from follicles that have atrophied and basically are nothing more than limb hairs in terms of their appearance, and there are hairs from the scalp that have no value for comparison purposes. Also if you are dealing with hair clippings and fragments of hair. Generally I work with head hairs and public hairs; although, I will work with hair clippings and fragments of hair if there are good individual characteristics present.

Hicks: Does any other panel member want to address that question?

Wittig: Let me say a bundle of hair is excellent. Some hairs when they are pulled out forcibly have root and sheath materials. This is wonderful. A fragment of hair - the size of a fingertip - we do not compare; so it is not the norm to say normally because it depends on the many different situations that occur in a case.

We first look at the case situation and then decide, if we can, if it is meaningful to compare.

Hicks: Good. Dr. Roe, would you please comment?

Roe: I feel Drs. Deadman and Wittig have summarized my feelings, and I think I speak for my colleagues at the Metropolitan Police Forensic Science Laboratory and probably my Home Office colleagues as well.

Hicks: Mr. Gaudette, would you please comment?

Gaudette: As far as what is required for comparison it does not really matter what type of a sample you have for comparison purposes. The quality of the questioned hair in terms of evidential value is

Hicks: Dr. De Forest, do you want to start with that?

De Forest: I think your answer was good. It was indistinguishable from the known sample and exhibited all the characteristics of a known sample. It could not be differentiated from a known sample, things like that.

Deadman: I want to point out that generally no two objects are identical in all characteristics and when I say something is similar or exhibits the same characteristics there are no significant differences.

Wigg: Let me comment on similarity. I hope Dr. Werner is with us. He is an anthropologist and anthropologists as well as biologists, namely evolutionists, are well aware of the fact that the measurement of similarity means relationship.

This is a point I mentioned at Oxford University too. When I answer the need to look for analytical techniques (in addition, I never said microscopy is not flawed), it is the first necessary step of course, but being aware of hairs as a pattern - composed of different components and consisting of appearing properties and features which we can see by microscopy - being aware of these effects we cannot say identity in the sense of similarity.

We should then focus our efforts on adding different analytical techniques, making measurable features, or numerical, then transfer it in the scale of one to two. It is not different from the idea Mr. Claudette has, if I understood correctly, namely, to figure to the scale of similarity which is arbitrary but then can be given in reliable percentages.

Roe: I have been asked basically that same question more than once and I usually comment something to the effect that the hairs on the head usually exhibit a range of characteristics.

The questioned hair in this case fits within that range. I was not able to find anything which indicated that it might not have come from that source; therefore, it was microscopically similar to that source.

Gaudette: A phrase I prefer to use in that kind of situation is, "no unexplained forensically significant differences between the questioned hair and the known sample."

Along the line of the comment you made, I should point out an interesting approach that is being taken in a collaborative test that is presently being taken in Dr. Roe's laboratory. In that test it is my understanding that participants are being asked not only to determine whether or not the questioned and known hairs are similar, but to rate on a scale of one to ten their confidence in that finding, and this I think should generate some interesting results.

Hicks: One last question.

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measured when you state your conclusion and your opinion, and there are a number of factors which have been enumerated by other people that can strengthen or weaken the evidential value of given hair. Sometimes they can be found in combination even when they balance out. So it depends on the evidential case.

Hicks: Is there another question?

Question: Dr. De Forest, several years ago you coauthored or at least sponsored a paper that was published by a gentleman who was studying under you, I believe his name was Ron Chahuday, who did a paper on scanning electron microscopic analysis of hairs using a sulphur treatment. He claimed individualization of hairs, at least with the 30 hair samples he worked with.

I was wondering what is the status of that study, because I have not seen a follow-up at all. I am curious.

De Forest: Like a lot of things that should be taken further it was not. It was a limited study. For those who are not familiar with the study, it was a study of chemically modified hairs: hairs that were modified by disulphide agents. The X-ray or topography of the hair was very atypical and it seemed to be tied into the individuals who donated the hairs. The hairs gave a consistent morphology generated for each individual, but there was a limited number of people in the study and it was not taken any further.

Hicks: There is a question in the back.

Podlecki: Ten years ago I was on a murder case in which the only evidence they had was one hair and it was found on the victim's body. I compared it to see if it was similar. When we are on the stand we always wonder what is the defense attorney going to ask us?

Within the last 14 years an attorney said to me, "A person who does not do a lot of hair comparisons or just starts out in the field sometimes get stumped." Then he asked, "How similar was that hair?"

How would members of the panel answer that question. If an attorney asked you that, and you then went through your explanation and told him, "Well, you know they are similar," and "They are consistent with the known hair," then the attorney asks you, "How similar? Does that mean like very similar?" You know you do not want to get involved in percentages. The way I have answered that question, and it has been upheld in the appellate court, was they were similar to the extent that I could not find any apparent dissimilarities among the standards.

I was wondering if there is anything that would be different in a panel member's answer to that question?

Question: It seems the panel members came up with a good explanation of what they thought similar means.

I am sure all the hair examiners here run into the same problem that lay people do; similar and not similar are equivalent statements. We all know that they are not equivalent statements, but it seems that we would behave as to perhaps change some of our terminology. Similar is so ambiguous that I do not think it projects our confidence in the examination itself.

I would like to pose a question to Dr. De Forest concerning what Mr. Gaudette said about bringing up the levels of confidence of rating. Dr. De Forest, from a defense point of view how would you approach a report from a laboratory that rates their examinations from good, better, or best and inconclusive?

De Forest: Normally, when I get a case like this, I first get the laboratory report and if it is not very informative, then with the permission of the attorney I will ask to call the examiner and find out the examiner's confidence, if it is somebody I know and so forth. Then I can assure the attorney there is a very good likelihood that there would be no point in having the hairs reexamined.

Question: Some laboratories simply use a positive association, negative association, or inconclusive. Some laboratories I understand will grade the terminology in the report as how confident they are in the match. My question is if they are not confident in the match, why did they grade how confident they are in the report. It either is not or it is inconclusive.

De Forest: There is discussion in the Committee about how a report could be worded. Dr. Roe, you are the best one to deal with that?

Deadman: I think the only thing we concluded at this point was that we felt the terms "microscopically like" as the most suitable ones for report. Unless someone else would like to comment on that. Stephen Stauffer, did you do that in the Terminology Definition and Standardization Subcommittee?

Stauffer: No. I might point out that it does not matter what terminology is used as long as it is explained to the court and to the jury in an educational manner before the results are mentioned.

It does not really matter what terms are used. Certainly with hairs, most people are not even aware hairs are utilized as evidence. I think you need to explain to the jury what your examination involves and what your results mean. Certainly if there is a defense expert involved, the defense expert will explain his/her understanding of the examination and what it means, and so forth. You should certainly do this in any type of case, especially with hairs.

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In reference to your other comment about interpreting the conclusion that an association has been made, I have always debated attempting to put in my report on interpretation of the strength of the association that I have made through hairs or fibers.

In some cases I have had extremely strong fiber evidence or hair evidence, or a combination of the two, and have made a statement to the effect that the chances of these hairs originating from some other source or these fibers from some other source are extremely remote.

I do not often do that. I set forth my results and my associations and I interpret those results in court. In some respects, that is a cop out, because basically you are going into court with a defense attorney who does not have the faintest idea, if he has not done his homework, what you are going to say. He assumes you are going to be making some associations and that is it, and then you hit him with an extremely strong association.

But it is very hard to interpret. If you have an overwhelming association, certainly you can interpret that and you probably should. If you have a very weak association you should qualify your association. It is the ones in between that are very hard to put a comment on as to the value of the hair or fiber evidence.

Hicks: From the nature of the questions and responses it is very apparent that hair identifications or hair comparisons are a very subjective type of analysis. We seem to be struggling with questions like, what really constitutes an adequate sample; what constitutes an adequate questioned specimen; and how significant is a hair comparison?

We have stressed the importance of adequate training. But even with training I suspect there are not any well established standards of what really constitutes an adequate training program and what experience level of an examiner is really meaningful.

Would any of the panel members like to comment on that thought? Where do we go from here? How do we address the problem of subjectivity of the hair examination? How can we get around these questions so as to help establish the significance of the hair association? How can we articulate what really constitutes an adequate sample?

De Forest: It is clear more has to be done. We have to have ongoing research, more meetings and discuss terminology so as further our knowledge of hair. We are on our way through the FBI sponsorship of the Committee of Forensic Hair Cooperation. I feel it should be an ongoing committee. We have not solved all the problems by any means.

Deadman: In my opinion the only way to really measure the skill or ability of a hair examiner is to subject that examiner to matching tests. I think this

should be the basis of all training programs. I think this should be the basis of quality assurance and proficiency testing program. We are trying to develop such a vehicle in the Committee on Forensic Hair Comparison.

As mentioned earlier, the Metropolitan Police Forensic Science Laboratory is trying to develop a proficiency test which a number of laboratories in the United States and Canada have agreed to take. Based on the test's description, it looks like it would be extremely difficult. Again, it depends quite a bit on the hairs and how they are selected.

But matching tests are essentially the same thing you are doing in case work. I think it is the only way to measure an examiner's ability.

Wittig: I would be happy if we could take part in such a system. We have not, as I have said. I hope that in the future we may establish the need for independent analysis, as I have said in lectures at various meetings.

I had an idea as we were discussing confidence in matching. A serologist will be asked, "have you done one, two, three and so on?" Should we not be asked the same when having found a matching hair in microscopy so we are convinced it should be coming from the same source? Then to support this view by ABO grouping.

We do not normally do so in every case, because it is time consuming. But would not it be consequent to demand this when we find a match and want to get more confidence?

Hicks: Thank you.

Roe: I think further research is vital, particularly on objective characteristics which will be used to back up the microscopic match.

I believe it is essential for the United Kingdom to maintain full liaison with the United States and Canada in this regard. I think they have positively made us sit up and think. We have to move toward your way of doing things. I am firmly convinced of this, and our training quite frankly would appear inadequate at the moment. Of course, I speak for myself here. I do not speak for my other. I do not even speak for the whole Metropolitan Police Forensic Science Laboratory in that case. That is a personal opinion and seeing as I am the one who does a fair proportion of it in the Metropolitan Police Forensic Science Laboratory, it is obviously not up to your standards.

I think our quality assurance program should involve much more of the testing in the way as has been described that is used in the United States.

Where do we both go from here, I am not sure, but as long as we cooperate perhaps we will get there together.

Gaudette: I would like to echo Dr. Deadman's comment with regard to matching tests. I think it is the key to the whole question: matching tests first

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of all for training; matching tests for quality assurance (in that case they are called proficiency tests); matching tests to evaluate new methods (in which case I found the collaborative studies along the lines of what I did with the cross-section research project I spoke of earlier); and matching tests finally to evaluate how well the system works. If we can really do good work on hair comparison, the proof is in the pudding. The matching tests will tell whether it is good or bad.

Hicks: Thank you very much. Panel members, thank you for your responses and your participation.

Post-panel contribution comments from Dr. Wittig.

There is just one point I would like to mention: communication. Mathematics would be the most exact and unambiguous form to communicate. Applied to the problems of hair evidential value the work of Barry Gaudette (1982, 1984) and contributions by others (Burnett and Ogilvie 1982; Altken and Robertson 1984; Peabody *et al.* 1983) deserve particular appreciation. However, for the greater part of hair matters and related problems we necessarily have to discuss things verbally, even by use of colloquial language. What we need to have is common vocabulary, not terms only but definitions too [see respective efforts of the Subcommittee on Terminology Definition and Standardization of the Committee on Forensic Hair Comparison (Committee on Forensic Hair Comparison 1985)]. We have become aware of this need again during this symposium. The problem becomes even more complicated when it comes to communicate internationally. Thus common language is a *jolie qua non*. Believe it or not, it was hair that caused me to "brush up" my English knowledge. I had to because I felt that scientific communication in regards to forensic science hair matters was, and still is, a need. Stuart Kind, successor of Dr. Curry as Director at HOORE, was the first I attempted to contact that way. Being a biologist he is one of those heads in Forensic Sciences who may justly be called a supporter of efforts at our so complex "hairy" problem. By the way, communicating in a foreign language is almost as much an adventure as scientifically dealing with hair is; and advancing depends on experiencing, likewise.

Anyways, meetings like this symposium, freedom of prejudice and mutual efforts to learn from each other, make up valuable elements in the process of advancing forensic hair comparison as a science, and above that, of establishing trichology as a scientific discipline within the international forensic science community (Wittig 1984).

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